The application of AI technologies in STEM education: a systematic review from 2011 to 2021

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Abstract

Background The application of artificial intelligence (AI) in STEM education (AI-STEM), as an emerging field, is confronted with a challenge of integrating diverse AI techniques and complex educational elements to meet instructional and learning needs. To gain a comprehensive understanding of AI applications in STEM education, this study conducted a systematic review to examine 63 empirical AI-STEM research from 2011 to 2021, grounded upon a general system theory (GST) framework. Results The results examined the major elements in the AI-STEM system as well as the effects of AI in STEM education. Six categories of AI applications were summarized and the results further showed the distribution relationships of the AI categories with other elements (i.e., information, subject, medium, environment) in AI-STEM. Moreover, the review revealed the educational and technological effects of AI in STEM education. Conclusions The application of AI technology in STEM education is confronted with the challenge of integrating diverse AI techniques in the complex STEM educational system. Grounded upon a GST framework, this research reviewed the empirical AI-STEM studies from 2011 to 2021 and proposed educational, technological, and theoretical implications to apply AI techniques in STEM education. Overall, the potential of AI technology for enhancing STEM education is fertile ground to be further explored together with studies aimed at investigating the integration of technology and educational system.